1. A test apparatus for measuring with approximately microscale spatial resolution the velocity of fluid flow in a passageway, comprising:

a test device having a transparent wall through which the flowing fluid may be observed, and adapted to have injected therein fluorescent particles having an excitation wavelength and an emission wavelength;

a light source for repetitively delivering a pair of closely spaced pulses of light to the fluid flow with a known time delay, being operable to broadly illuminate the entire test device with each light pulse such that fluorescent light is emitted from the particles at the emission wavelength;

a mirror positioned between the light source and the test device and being angularly positioned to reflect light from the light source to the test device, the mirror being coated to generally reflect light at the excitation wavelength and to generally transmit light at the emission wavelength;

a microscope lens positioned between the mirror and the test device for receiving light reflected from the mirror and transmitting it to the test device, the microscope lens having a high numerical aperture and a high magnification with a depth of field that defines a two-dimensional plane within the flowing fluid;

an image recording device positioned to receive fluorescent light transmitted from the test device through the microscope lens and the mirror; and

a barrier filter positioned between the mirror and the image recording device for passing light at the emission wavelength while rejecting light at the excitation wavelength;

wherein an out of plane measurement domain is determined by the depth of field of the microscope lens.

2. The apparatus of Claim 1 wherein said light source is a pulsed monochromatic light source, and said apparatus further comprises beam forming optics following said pulsed monochromatic light source.

3. The apparatus of Claim 1 wherein said light source is a pulsed chromatic light source, and said apparatus further comprises:

beam forming optics following said pulsed chromatic light source; and

an excitation filter following said beam forming optics.

4. The apparatus of Claim 1 wherein the separation of said closely spaced pulses of light is of the order of five nanoseconds, and the known time delay is in the approximate range of several nanoseconds to several seconds.

5. A test apparatus for measuring with approximately microscale spatial resolution the velocity of fluid flow in a passageway, comprising:

a test device having a transparent wall through which the flowing fluid may be observed, and adapted to have injected therein fluorescent particles having an excitation wavelength and an emission wavelength;

a light source for delivering pulses of light to the fluid flow, being operable to broadly illuminate the entire test device with each light pulse such that fluorescent light is emitted from the particles at the emission wavelength;

a mirror positioned between the light source and the test device and being angularly positioned to reflect light from the light source to the test device, the mirror being coated to generally reflect light at the excitation wavelength and to generally transmit light at the emission wavelength;

a microscope lens positioned between the mirror and the test device for receiving light reflected from the mirror and transmitting it to the test device, the microscope lens having a high numerical aperture and a high magnification with a depth of field that defines a two-dimensional plane within the flowing fluid;

an image recording device positioned to receive fluorescent light transmitted from the test device through the microscope lens and the mirror; and

a barrier filter positioned between the mirror and the image recording device for passing light at the emission wavelength while rejecting light at the excitation wavelength;

wherein an out of plane measurement domain is determined by the depth of field of the microscope lens.

6. The apparatus of Claim 5 which delivers a pair of closely spaced pulses of light with a known time delay.

7. The apparatus of Claim 6 wherein the separation of said closely spaced pulses of light is of the order of five nanoseconds, and the known time delay is in the approximate range of several nanoseconds to several seconds.

8. The apparatus of Claim 6 wherein said light source is a continuous monochromatic light source, and said apparatus further comprises:

beam forming optics following said pulsed monochromatic light source;

one or more relay lenses disposed immediately following said barrier filter in the direction of said image recording device; and

a shutter disposed between said light source and said image recording device.

9. The apparatus of Claim 6 wherein said shutter is an electro-optical shutter.

10. The apparatus of Claim 6 wherein said shutter is a mechanical shutter.

11. The apparatus of Claim 6 wherein said light source is a continuous chromatic light source, and said apparatus further comprises:

beam forming optics following said continuous chromatic light source;

an excitation filter following said beam forming optics;

one or more relay lenses disposed immediately following said barrier filter in the direction of said image recording device; and

a shutter disposed between said one or more relay lenses and said image recording device.

12. The apparatus of Claim 6 wherein said shutter is an electro-optical shutter.

13. The apparatus of Claim 6 wherein said shutter is a mechanical shutter.

14. A method of measuring with approximately microscale spatial resolution the velocity of flow of a flowing fluid, the method comprising the steps of:

(a) placing in the fluid a plurality of substantially evenly distributed solid particles containing fluorescent dye;

(b) selecting an optical apparatus having an objective lens;

(c) applying light through the objective lens of the optical apparatus to the fluid during at least two separate and discrete time periods so that the solid particles will then emit fluorescent light;

(d) transmitting the fluorescent light emitted by the particles through the objective lens so that the depth of field of the objective lens will then define a two-dimensional out of plane measurement domain within the flowing fluid; and

(e) recording the thus-received fluorescent light during the discrete time periods.

15. The method of Claim 14 which further includes the step of then analyzing the successively recorded time sequence of discrete fluorescent particle images by average correlation analysis at multiple points within the image field to determine the average fluid velocities at multiple respective points within the two-dimensional measurement plane.

16. A test apparatus for measuring with approximately microscale spatial resolution the velocity of fluid flow in a passageway, comprising:

a test device having a transparent wall through which the fluid may be observed;

a light source for delivering spaced pulses of light in a direction generally parallel to the plane of the fluid flow;

a mirror positioned between the light source and the test device and being angularly positioned to reflect light from the light source to the test device;

a microscope lens positioned between the mirror and the test device for receiving light reflected from the mirror and transmitting it to the test device, to define a two-dimensional plane within the flowing fluid;

the light source being operable to broadly illuminate the entire test device and the fluorescent particles flowing therein;

the mirror being coated to generally reflect light from the light source to the test device and to receive and generally transmit light received from the microscope lens;

an image recording device positioned behind the mirror to receive the light that is transmitted from the test device through the microscope lens and transmitted through the mirror; and

a barrier filter positioned between the mirror and the image recording device for filtering out the original pulses of light so that only fluorescent light generated by the solid particles may be observed;

wherein an out of plane measurement domain is determined by the depth of field of the objective lens.

17. The apparatus of Claim 16 wherein the light source is adapted to repetitively deliver a pair of closely spaced pulses of light.

18. The apparatus of Claim 17 wherein the separation of said closely spaced pulses of light is of the order of five nanoseconds, and a known time delay between repetition thereof is in the approximate range of several nanoseconds to several seconds.

19. The apparatus of Claim 17 which further includes means associated with the image recording device for analyzing the successively recorded fluorescent particle images by average correlation analysis to determine the average fluid velocities at multiple respective points within the two-dimensional measurement plane.